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Report No. 8926-155

Material - Elastomers - Teflon, Neoprene, TA-77 Synthetic Rubber (T. A. Manufacturing Corp.)

Aromatic Fuel and Weathering Resistance

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Abstract:

Suitable specimens of general purpose neoprene AMS 3209; aromatic fuel resistant neoprene AMS 3215; TA-77 synthetic rubber (T. A. Manufacturing Corporation, Los Angeles, Calif.); and teflon were subjected to various environmental tests. Atlas Type XW Weatherometer exposure for 250 hours and ozone exposures (ASTM Method 1149-55T) resulted in no cracking in the teflon and general purpose neoprene AMS 3209, but the T.A. synthetic rubber and aromatic fuel resistant neoprene AMS 3215 cracked. Heating at 212°F for 70 hours did not appreciably harden any of the four materials. Twenty-four hours immersion in JP4 fuel caused only very slight swelling of teflon, but the two neoprene materials and the TA-77 synthetic rubber swelled considerably as a result of immersion.

Reference: Mark, H., George, J. C., Keller, E. E., "Aromatic Fuel Resistance and Weathering Test on Fuel Line Support Clamps," General Dynamics/Convair Report MP 60-063, San Diego, California, 19 April 1960. (Reference attached).

CONVAIR
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STRUCTURES-MATERIALSLLABORATORIES

REPORT MP 60-063
DATE 19 April 1960
MODEL 30

TITLE

REPORT NO. MP-60-063

AROMATIC FUEL RESISTANCE

and

WEATHERING TEST ON FUEL LINE SUPPORT CLAMPS

MODEL 30

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FOREWORD

This test was initiated to compare the weathering, ozone and aromatic fuel resistance of TA-77, a rubber material manufactured by T. A. Manufacturing Corporation, 4607 Alger Street, Los Angeles, California with Teflon for use on fuel line support clamps. General purpose Neoprene AMS 3209 and Aromatic Fuel Resistant Neoprene AMS 3215 rubbers were tested under the same conditions as controls.

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Aromatic Fuel Resistance and
Weathering Test on Fuel Line Support Clamps-Mod. 30

SUMMARY

Laboratory tests were conducted on various rubber materials and Teflon for use on fuel line support clamps.

Exposure tests in a weatherometer, ozone, hot air and aromatic fuel were performed, and the resistance of these materials towards the various exposures were determined by changes in tensile strength, elongation, hardness, swelling and visual and microscopic appearances.

Rubber material TA 77, manufactured by T.A. Manufacturing Corporation, 4607 Alger Street, Los Angeles, California, and Aromatic Fuel Resistant Neoprene AMS 3215, showed cracking failures in the ozone test. Microscopic cracking occurred with the TA 77 material in the weatherometer test.

OBJECT:

To evaluluate TA-77, a rubber material, as a replacement for Teflon in existing fuel line support clamps.

CONCLUSIONS:

1. TA-77 material cannot satisfactorily replace Teflon in existing fuel line support clamps because of inferior aromatic fuel resistance and weathering as shown by cracking failures in the ozone and weatherometer tests.

2. General Purpose Neoprene AMS 3209 was found to be superior to TA-77 and Aromatic Fuel Resistant Neoprene AMS-3215 in weathering, but inferior in aromatic fuel resistance.

SPECIMENS AND PROCEDURES

TEST SPECIMENS:

The following materials were tested:

1. General Purpose Neoprene AMS 3209.

2. Aromatic Fuel Resistant Neoprene AMS 3215.

3. TA-77 manufactured by T. A. Manufacturing Corporation, 4607 Alger Street, Los Angeles, California.

4. Teflon

TEST PROCEDURES:

The specimens were exposed for weathering in an Atlas type X W Weatherometer for two hundred and fifty (250) hours in accordance with Specification TT-P-141b, method 615.2. Tensile strength, elongation, Shore durometer hardness and microscopic examinations were made before and after exposure.

The specimens were exposed to hot air in an oven at 212°F. for seventy (70) hours. Tensile strength, elongation and hardness of the specimens before and after exposure were obtained.

TEST PROCEDURES: (Continued)

The ozone exposure test was conducted by a method similar to ASTM Designation (1149-55T). A Westinghouse Electric High Ozone Generating lamp was used as a source of ozone and was connected in series with a 67 Watt (signal light) lamp. This was connected to a 110 volt circuit to reduce the ozone lamp input to 12 volts. The lamp was sealed in a resin jar. Air was passed into the jar and exited into another resin jar which contained the specimens that were subjected to ozone. The exhaust of the specimen resin jar was bubbled through a two gang bubbler containing 2 normal potassium iodide. The potassium iodide was then titrated against.01 normal sodium thiosulfate after a run to determine the ozone content. The test was made at 120°F in accordance with ASTM Designation CD 1149-55T). The ozone concentration was 13 parts of ozone per 100 million parts of air. Photographs of the specimens before and after exposure were obtained.

The specimens were exposed to JP-4 for twenty-four (24) hours and percentage volume change and hardness was obtained. The volume was determined by loss in weight in distilled water before and after immersion in the aromatic fuel.

RESULTS AND DISCUSSION:

The results of this test are shown in Table I.

It was found that TA 77 showed microscopic cracking over the entire surface after the weatherometer exposure. This cracking could not be detected with the naked eye and appeared to be surface cracking. The cracking after two hundred and fifty (250) hours exposure in the weatherometer was not severe enough to affect the physical properties appreciably.

Aromatic Fuel Resistant Neoprene AMS 3215 and TA 77 showed cracking after the ozone exposure test. Figure 1 shows this cracking after thirty-three (33) hours exposure in an ozone concentration of 13 parts of ozone per 100 million parts of air. The specimens were bent in a loop and the materials were under stress in this test as shown in the photograph. General Purpose Neoprene AMS 3209 and Teflon did not show any cracking during the ozone and weatherometer tests.

Although ozone is present during the weatherometer exposure, no cracking of the Aromatic Fuel Resistant Neoprene AMS 3215 occurred. This is possibly due to the fact that materials were not under stress in this test or the ozone concentration was not high enough to cause cracking.

Teflon showed the least swelling in JP-4. General Purpose Neoprene AMS 3209 swelled the most, while the swelling of Aromatic Fuel Resistant Neoprene 3215 and TA 77 were approximately equal.

RESULTS AND DISCUSSION: (Continued)

The hardness of all the materials was not appreciably affected after the oven, weatherometer and aromatic fuel exposure tests.

The physical property tests of the materials were not too significant, since the materials in actual service are subjected more to wear and abrasion rather than tension. All the physical test failures occurred in the gripping areas, and it is possible that the grips cut the materials. Standard specimens normally used for tensile tests were not available.

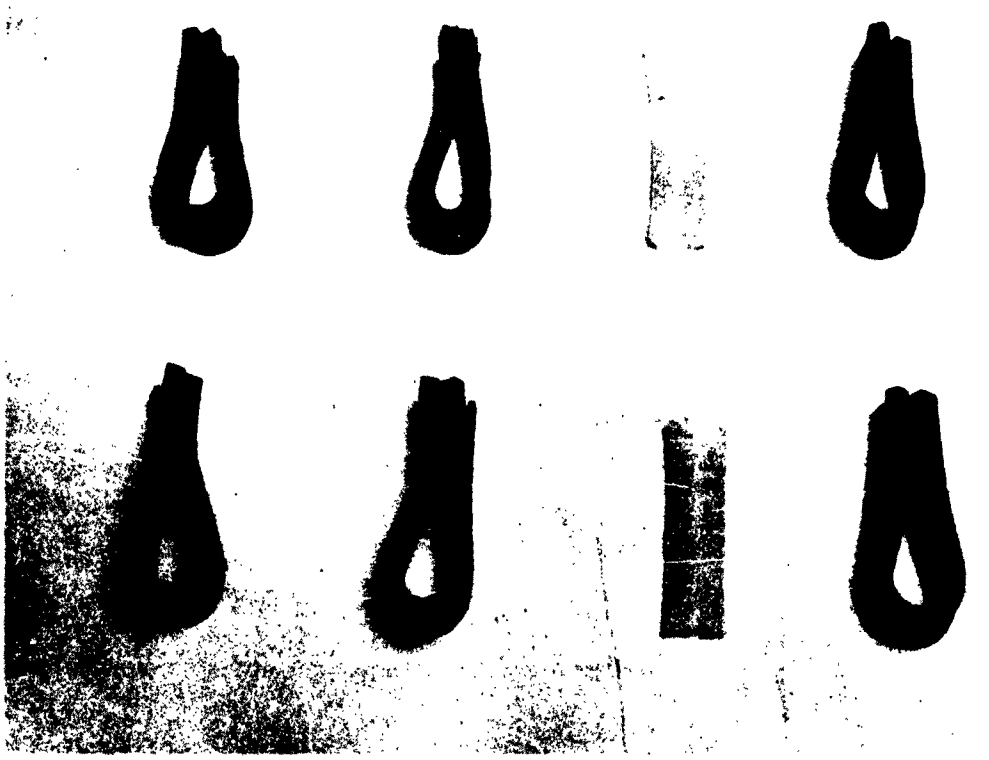
Tensile tests were not obtained on the Teflon material because of slipping. It was not possible to get an adequate grip on the specimen.

The load required to fail the specimen after the oven and weatherometer exposures remained approximately the same as the original.

The elongation for General Purpose Neoprene AMS-3209 and Aromatic Fuel Resistant Neoprene AMS 3215 were lower after the oven and weatherometer exposure, indicating that they could not stretch or yield as much, and were affected by the exposures. TA 77 was superior to the General Purpose Neoprene 3209 and Aromatic Fuel Resistant Neoprene AMS 3215 after they had been subjected to the oven and weatherometer since it had more elasticity under load. However, the General Purpose Neoprene AMS 3209 and Aromatic Fuel Resistant Neoprene AMS-3215 came back to their original shape, while the TA 77 showed permanent set.

NOTE: The data from which this report was prepared are recorded in Engineering Test Laboratories Data Book No. 3056.

Figure 1. Results of Ozone Exposure Test after 33 hours (concentration: 13 parts of ozone per 100 million parts of air, temperature 120°F.)



Notes: Upper Specimens had been exposed to ozone.

Lower Specimens were not exposed. (Control)

Left to Right. (1) General Purpose Neoprene AMS 3209.
(2) Aromatic Fuel Resistant Neoprene AMS 3215.
(3) Teflon.
(4) TA 77.

TABLE I

RESULTS OF TESTS

MATERIAL	General Purpose Neoprene AMS 3209	Aromatic Fuel Resistant Neoprene AMS 3215	Teflon	TA 77
Swelling (% Volume Change)	32.8	20.0	0.22	20.3
Visual Examination (naked eye) after Weatherometer Exposure	Satisfactory	Satisfactory	Satisfactory	Satisfactory
Micrpscopic Examination after Weatherometer Exposure	No cracking	No cracking	No cracking	Surface cracking
Visual Examination after Ozone Exposure Test	No cracking	Cracked	No cracking	Cracked
Shore Durometer Hardness (Original)	65	65	96	55
Shore Durometer Hardness (Oven Test)	65	65	96	55
Shore Durometer Hardness (JP-4 Immersion)	61	61	94	53
Shore Durometer Hardness (Weatherometer)	63	65	95	55
Tensile Tests (Original)				
Load (lbs.) "	72.0	76.0	---	81.5
% Elongation under load (Original)	1200.	1200.	---	825.
% Elongation after 10 minutes (Original)	9.0	8.0	---	50.0
Tensile Tests (Weatherometer)				
Load (lbs.) "	82.0	85.0	---	79.0
% Elongation under load "	125.	275.	---	610.
% Elongation after 10 minutes "	0	0	---	50.
Tensile Tests (Oven Exposure)				
Load (lbs.) " "	85.0	74.0	---	90.0
% Elongation under load (Oven Exposure)	120.	105.	---	1300.
% Elongation after 10 minutes " "	2.	0	---	88.